Assessment of shear bond strength between composite resin and enamel surface after treating with acid etching and laser etching: A comparative study

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ABSTRACT

Background: To compare the shear bond strength of composite resin to enamel surface with laser etching and acid etching.

Materials and methods: 40 recently extracted maxillary canines have been used to conduct this study. These were primarily sectioned into two groups:Group A: samples which underwent acid etching followed by enamel bonding, and Group B: samples which underwent laser etching followed by enamel bonding.Thereafter, all samples were bonded with composite resin. Shear bond strength was assessed.

Results: Group A was found to have mean shear bond strength of 33.2 MPa whereas group B was found to have mean shear bond strength of 18.3 MPa. After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group.

Conclusion: The mean shear bond strength of composite was higher after acid etching as compared to composite bonded after laser etching.

Keywords: Composite resin, acid etching, laser etching

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INTRODUCTION

Current understanding of the adhesion of dental restorative materials is based on two fundamental theories. One theory is based on chemical adhesion, describing intermolecular forces at the interface and the other theory is based on micromechanical retention; attributing adhesion to the interpenetration of components of the two surfaces. Cavity preparation with rotary instruments or manual scalers leaves a smear layer on the dental surface. The low surface energy of this layer hinders the impregnation of the tissue with the adhesive agent and thus prevents adequate adhesion. Since the report of Buonocuore, the standard approach to this problem has been acid etching.[1-3]

Acid etching of the enamel appears to improve the retention by selectively eroding certain hydroxyapatite formations and facilitating the penetration with the development of resin tags of about 6-12 mm in length. Various procedures for acid etching have been proposed, though the most widely used at present for enamel is 37% phosphoric acid for 15 s.[4-6]Development of laser technology has enabled its use in multiple dental procedures, such as soft tissue operations, composite restorations, tooth bleaching, caries removal, and tooth preparations with minimal pain and discomfort.[6]Hence; the present study was conducted for assessing and comparing theshear bond strength of composite resin to enamel surface with laser etching and acid etching.

MATERIALS AND METHODS

40 recently extracted maxillary canines have been used to conduct this study. These were then primarily sectioned into two groups:Group A: samples which underwent acid etching followed by enamel bonding, and Group B: samples which underwent laser etching followed by enamel bonding. Composite bonding to enamel surface was done according to the protocol of each group. Teeth were dried after the etching process and thereafter light cure bonding agent was applied. All

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specimens were evaluated by universal force testing machine to compare their shear bond strength.SPSS software was used to examine the results, which were stored in Microsoft excel sheet.

RESULTS

Group A was found to have mean shear bond strength of 33.2 MPa whereas group B was found to have mean shear bond strength of 18.3 MPa. After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group.

Table 1: Mean shear bond strength among specimens of both the study groups

Group	Mean shear bond strength (MPa)	SD	t- value	p- value
Group 1	33.2	1.08	43.22	0.001 (Significant)
Group 2	18.3	1.13		

DISCUSSION

Composite resin restorations are commonly used to restore dental structures, but they typically illustrate lower bond strength when used on dentin compared with enamel. Progressing to increase the strength of this bond, several adhesive systems have been introduced. Per the technique used and also the mechanism of adhesion, adhesive systems are broadly categorized into two main categories: total- etch and self- etch adhesive systems. Many companies produce total- etch adhesive systems as either a three- step system (acid etchant, primer, and adhesive) or a two- step system (acid etchant, and a combination of primer and adhesive in a single bottle). Self- etch adhesive systems are composed of a self- etching primer and an adhesive resin that's either provided in two separate bottles (two- step system) or combined in a single bottle (one- step system). Three- step total- etch adhesives are believed to be the gold standard in enamel bonding thanks to the effective bond formed after the utilization of the solvent- free, neutral pH, hydrophobic, and adhesive resin layer as a separate step.[6- 9]Hence; the present study was conducted for assessing and comparing theshear bond strength of composite resin to enamel surface with laser etching and acid etching.

Group A was found to have mean shear bond strength of 33.2 MPa whereas group B was found to have mean shear bond strength of 18.3 MPa.Al Habdan AH et al compared the shear bond strength of enamel or dentin conditioned with either Er,Cr:YSGG (erbium, chromium: yttrium–scandium–gallium–garnet) laser or phosphoric acid to composite resin restoration.Forty posterior human extracted teeth were used. After mesiodistal sectioning of the teeth crowns, the samples were randomly divided into two groups—in the first group (E), bonding was performed on the enamel after roughening and in the second group (D), the enamel was removed and bonding was performed on the dentin. These groups were further randomly divided into two subgroups according to the type of etching (n = 20 each). In the acid- etched groups (EA and DA), the surfaces were etched with 37% phosphoric acid. In the laser- conditioned groups (EL and DL), the surfaces were conditioned with Er,Cr:YSGG laser. Total- etch adhesive system was used to bond all the 80 specimens resin composite. The highest shear bond strength was observed for the DA group (16.25 ± 1.10 MPa, $p < 0.0001$), whereas the lowest was observed for the DL group (8.56 ± 0.67 MPa). The adhesive failure mode was the most frequently observed in all groups.The shear bond strength of composite resin bonded to enamel and dentin etched with phosphoric acid was higher than when conditioned with Er,Cr:YSGG laser.[10]

After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group. Bahrololoomi Zet al evaluated the effect of tooth preparation with bur and Er:YAG laser on shear bond strength of composite to enamel and dentin of primary teeth.Seventy-five primary molar teeth were collected and 150 specimens were obtained by mesiodistal sectioning of each tooth. In each of the enamel and dentin groups, the teeth were randomly assigned to 3 subgroups with the following preparations: bur preparation + etching (37% H3PO4), laser preparation + etching, and laser preparation without etching. Single Bond adhesive and Z250 composite were applied to all samples. The bond strength of enamel specimens was significantly higher than that of dentin specimens, except for the laser-non-etched groups. The enamel and dentin laser-non-etched groups had no significant difference in bond strength. In both enamel and dentin groups, bur preparation + etching yielded the highest bond strength, followed by laser preparation + etching, and the laser preparation without etching yielded the lowest bond strength ($P < 0.001$).In both enamel and dentin groups, laser preparation caused lower shear bond strength compared to bur preparation.[11]

CONCLUSION

The mean shear bond strength of composite was higher after acid etching as compared to composite bonded after laser etching.

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